# Organizations of Knowledge

manuscript for:
Ann Blair, "Organizations of Knowledge," in Cambridge Companion to Renaissance Philosophy, ed. James Hankins (Cambridge: Cambridge University Press, 2007), pp. 287-303.

# Organizations of Knowledge in the Renaissance

The "organization of knowledge" is a large and diffuse topic which can be studied at many different levels, ranging from the way an individual orders his or her understanding of the world privately or in publications, to the ways in which communities or institutions order knowledge, notably in pedagogical curricula and textbooks, professional structures, libraries and library catalogs and other collective projects.[1] Although a few modern philosophers have addressed the problem of classifying knowledge, current practices of classification are mostly studied by anthropologists and sociologists.[2] Modern cultures and subcultures engage in both explicit and tacit classifications of knowledge, but today any particular organization of knowledge is generally acknowledged to involve a number of arbitrary choices and its success is often measured by pragmatic criteria of effectiveness, such as ease of use and economic efficiency. But this skeptical attitude toward the possibility of any organization matching the reality of knowledge or of the world is a fairly modern development, articulated for example in Jean Le Rond d'Alembert's "preliminary discourse" to the Encyclopédie of 1751.[3]

In Renaissance Europe, on the contrary, many thinkers harbored the ambition of implementing the perfect organization of knowledge, though pragmatic, notably alphabetical, arrangements were also widespread in certain contexts. During the Renaissance the difficulty of ordering knowledge was greatly exacerbated in almost every field by the massive influx of material to be included, stemming from newly discovered worlds and newly recovered ancient texts as well

as newly printed texts of all kinds, and by concurrent social and cultural changes associated with the development of printing, a rapid growth in higher education, and shifting patterns of patronage and social mobility. In this brief introduction to a complex topic I will focus on three areas in which Renaissance authors engaged in the organization of knowledge, proceeding from the least to the most pragmatic kinds of organization: explicit discussions of the classification of the disciplines; attempts at ordering historical and natural historical knowledge, especially in large-scale compilations; and the organization of things of various kinds, especially books in libraries, sales catalogs and bibliographies.

**Classification of the disciplines**

Of the different forms of the organization of knowledge, the classification of the disciplines has received the most attention from intellectual historians and historians of philosophy, with a special focus on the numerous medieval treatises devoted to the question and various specific studies pertaining to Renaissance and later classifications.[4] In discussing in a few passages the parts of philosophy Aristotle canonized the topic of classification for philosophical discussion for centuries to come, although he did not devote as much attention to the question as later commentators made it seem. Aristotle became known for a bipartite division of philosophy into speculative and practical branches. In a number of passages Aristotle proposed a tripartite division with an additional third branch for "poetic" or productive knowledge, but commentators on Aristotle generally subsumed the productive under the practical disciplines. In the bipartite division ascribed to Aristotle the theoretical disciplines comprised metaphysics, physics and mathematics, and the practical ones ethics, politics and economics; logic and rhetoric were not properly part of philosophy, but preparatory to it.[5] But ancient philosophy also bequeathed to later commentators an alternative division of philosophy--a tripartite scheme in which philosophy was divided into

logic/dialectic, ethics and physics (including a relatively important status for mathematics). This tripartite classification of the sciences was traditionally associated with Plato in what is now recognized as a false attribution (made by Sextus Empiricus and Augustine among others) of a scheme devised by the Stoics.[6]

The legacy of antiquity on classification included not only these bipartite and tripartite divisions of philosophy, but also the seven liberal arts which were the focus of Roman education and taught in Latin, in preparation for more advanced philosophical study which was generally pursued in Greek. Varro is credited with the first enumeration of the seven liberal arts, to which he added medicine and architecture, in his lost work, Disciplinarum libri IX (ca. 116-27 BCE). Clement of Alexandria and Augustine among other Church fathers hailed the seven liberal arts as preparation for Christian doctrine, thus authorizing their central place in the medieval curriculum.[7] But Greek philosophy became largely inaccessible to the Latin West except through the Latin summaries and commentaries of Boethius and Augustine among others. Boethius offered a classification of philosophy which synthesized the "Platonic"/Stoic within the bipartite Aristotelian scheme, including the quadrivium under theoretical philosophy. Boethius' classification proved particularly influential since it was adopted by Cassiodorus and mentioned by Isidore of Seville (alongside an alternative tripartite scheme) in their widely used manuals for the instruction of monks and priests respectively. Throughout the early middle ages educators and encyclopedists proposed a number of different classifications of the disciplines, featuring especially tripartite and bipartite divisions and the seven liberal arts.[8] The Didascalicon of Hugh of St Victor (1096-1141) marks the height of complexity of medieval classification prior to the recovery of Aristotelian philosophy. His division was quadripartite (theoretical, practical, mechanical and logical) and featured seven mechanical arts to match the seven liberal ones.[9]

The translation into Latin for the first time of many texts of Aristotelian philosophy, from

Arabic and directly from Greek in some cases, triggered the expansion of teaching beyond the seven liberal arts. Since logic had already been included in liberal arts teaching (as a branch of the trivium), the new disciplines which were added to the curriculum at the newly founded universities were the three philosophies (physics, metaphysics and ethics), themselves considered propedeutic to study in the higher faculties of medicine, law and theology. The recovery of Greek philosophy, accompanied by Arabic commentaries on it, coincided with the heyday of Latin treatises on the nature and division of the sciences, 1170-1270.[10] This classificatory activity can be understood as a response to the new texts, disciplines, methods and institutions introduced in the teaching of philosophy in this period. The new texts translated into Latin also included an Arabic classification of the sciences by al-Farabi which inspired two Latin translations and a number of commentaries.[11] By 1255 Vincent of Beauvais could thus enumerate without deciding among them eight different positions on the classification of the sciences in his Speculum doctrinale.[12]

The more substantial treatments of Aristotelian philosophy which were now possible fostered new debates about classification, notably debates about the proper position of mathematics and the scientiae mediae which would recur in the Renaissance. Following Aristotle, most medieval classifications ranked the parts of philosophy according to their level of abstraction. Physics abstracted from individual material entities to discuss the forms and substances of material objects in general and thus promised scientia or certain knowledge; metaphysics concerned objects which were not dependent on matter at all and was thus clearly superior. Despite the abstract nature of its focus on the numerical relations between things, mathematics was considered inferior to physics because it did not adequately account for the complexity of physical reality. While many scholastics shared this assessment, a small set of disciplines which Aristotle had called "subordinate" blossomed into a new category of "scientiae mediae"--intermediate between physics and mathematics because partaking of both--which increasingly challenged the sharp division and

hierarchy between the two parent fields.[13] Optics, the science of weights, the measurement of bodies (stereometry) and physical astronomy increasingly became objects of study at the medieval university (in part due to the translation of Arabic texts in these fields). A few scholastics, notably at Merton College in 14th-century Oxford, argued especially for their importance.[14]

The explicit discussion of the classification of the disciplines in the middle ages remained a part of theoretical philosophy, generating a few full-blown treatises and more commonly (especially after the 13th century) remarks in introductory sections to philosophical treatises. These discussions generally had little impact on what was taught or studied, but served as an opportunity for authors to position themselves and to innovate within the spectrum of options that developed from the engagement of successive generations with ancient classification schemes. Renaissance treatments of classification drew heavily on models and methods inherited from the middle ages, although this debt was often not acknowledged. On problems of classification the recovery of lost ancient texts played a comparatively minor role in the development of Renaissance thought.[15] Most Renaissance classifications of the disciplines attempted an eclectic integration of new or newly invigorated disciplines with the Aristotelian schemes inherited from the middle ages; even traditionalist Aristotelian classifications and curricula shifted the balance of the disciplines. Only a few authors proposed bold departures from the Aristotelian legacy.

Humanists often used their classifications to support new claims for the centrality of the disciplines they favored, whether grammar, dialectic, history or mathematics. A fine example of this strategy, widely circulated in its time and well studied today, is the Panepistemon of Angelo Poliziano, which began as an inaugural lecture in a course at the University of Florence, and was printed in numerous editions in Italy and in France, where it was also tacitly reused by at least two other authors. The vast array of sources Poliziano brought together in this eclectic synthesis of previous classifications is exemplary of the new range of humanist scholarship; his overarching

argument was also typical of humanist disciplinary priorities, in that he hailed the grammaticus, rather than the philosopher, as the omniscient scholar capable of studying all texts.[16]

The mechanical arts generally experienced a rise in status in Renaissance classifications--they were more consistently included, whereas previously they had often been left out altogether.[17] Although the modern notion of "fine arts" only appeared in the 18th century, painting and sculpture rose in status from their medieval standing as artisanal crafts; humanists debated not whether to include them among the arts and sciences, but whether to position them among the sciences or within eloquence as an art of expression.[18] Many disciplines once considered lowly and mechanical were given a lift in status by their association with mathematics--among them for example navigation, ballistics, and painting (e.g. through the use of perspective). In the 16th century mathematicians successfully touted the ancient pedigree of their discipline, which gained further prestige from the humanist recovery of texts of Greek mathematics and from the patronage of princes eager for both the prestige and the material benefits which mathematics promised.[19] Commentaries on Euclid offered the occasion for boasting of the areas which mathematics could encompass. In his commentary on Euclid Proclus had noted six kinds of mixed mathematics (already up from Aristotle's three); in his preface to the first English translation of Euclid in 1570, John Dee's list of mathematical disciplines named thirty fields of study, many of them terms which Dee coined for the first time in a bold forecast of mathematical achievements to come.[20]

Even among self-avowed Aristotelian traditionalists, the hierarchy of the disciplines in the 16th century was subject to new emphases as influential figures promoted their own disciplines and interests. Across Europe philosophy was to taught to younger students in this period than in the middle ages.[21] In the training of Jesuits at the Collegio Romano Christopher Clavius (1538-1612) successfully argued for a greater place for mathematics and the mixed sciences. This change helped to foster a new, mathematical approach to physics, along the lines of the interests of the Merton

school of the 14th century, though Clavius did not refer to them or to earlier medieval debates about the status of the "scientiae mediae."[22] Jacopo Zabarella at Padua argued in his treatise on the hierarchy of the disciplines for a greater autonomy for physics,[23] while the great Spanish scholastic Francisco Suarez (1548-1617) valued metaphysics above all as the discipline from which to prove God through reason.[24] Protestant scholastics also offered multiple variations on the traditional elements of classifications.[25]

Only a few late Renaissance figures openly rejected received classificatory schemes and the curricula to which they were related. In Paris of the 1550s and 1560s Petrus Ramus called for a complete overhaul of the university curriculum based on Aristotle. He proposed to replace it with a single, dialectical method applicable to all fields which promised easy mastery of a subject through the systematic use of definition and division. Ramus attributed his reliance on these principles, as well as his special praise of mathematics, to the inspiration of Plato.[26] Ramus had no lasting impact on the French curriculum, but developed a considerable following, especially after his death in the St Bartholomew's Day killings, among German and English Calvinists.[27] The notion of unifying the disciplines through a single method was a shocking reduction of the Aristotelian conception of method, according to which every discipline had its own method appropriate to its subject matter and level of abstraction.[28] Ramism is best known for the dichotomous diagrams used to lay out the divisions of each subject, but diagramming predated Ramus who was indebted to the visual presentations devised by an earlier generation of pedagogues, including Rudolph Agricola and Jacques Lefèvre d'Etaples.[29] Diagramming also proved more versatile than Ramus' particular method and was used not only by full-fledged Ramists but also to present more traditional schemes of the disciplines, as in the ornate tables of philosophy published by Christofle de Savigny (1587).[30]

Francis Bacon was another bold opponent of received classifications and sorted the disciplines not according to the usual criteria of degree of abstraction or type of subject matter, but

rather according to the three faculties of the mind--reason, memory and imagination. Bacon was likely inspired by a late antique interpretation of Galen's partition of the soul which circulated from the middle ages down to Bacon's day.[31] In his Advancement of learning (1605) and his own revised Latin translation of it in 1623 (as De augmentis scientiarum), Bacon emphasized the unity of the sciences and the role of practical as well as theoretical disciplines in furthering the governance of civil society.[32] His classification came to stand for the superiority of reason when d'Alembert selected it as the basis for his "tree of the sciences" in the Encyclopédie. But Bacon himself took no such position; he expected great things from history (a discipline of memory) and kept a place in his own work for the imagination (e.g. in the allegorical interpretation of ancient wisdom).

Changes in the classification of the disciplines during the Renaissance can be exemplified by the contrast between two encyclopedias organized around the disciplines--Gregor Reisch's Margarita philosophica (1503) and Johann Heinrich Alsted's Encyclopedia (1630). Reisch's 500-page quarto volume covered the seven liberal and the three philosophies. Alsted's four-volume work, totaling 2400 folio pages, encompassed much more material and all kinds of new disciplines, for many of which Alsted coined his own terms. Alsted's propedeutic praecognita were not the liberal arts, but rather, under the impact of Ramist thinking, focused on the methods of studying and the principles of the disciplines. Philologia was also preparatory to philosophy which was divided into theoretical and practical, followed by the three higher faculties. Alsted then described twenty-one mechanical arts (from brewing to playing musical instruments) and ended with a "farrago of disciplines" comprising forty-one fields of study from cabbala and the physics of Moses to the study of tobacco ("tobacologia"). In his attempt to harmonize all knowledge Alsted introduced in the farrago some fields which were incompatible with approaches described in the earlier sections of his work.[33] The fact that the content of Alsted's Encyclopedia was bursting out of even its eclectic system of classification is perhaps one of the reasons why the next generation of encyclopedias of

the disciplines was arranged alphabetically rather than systematically.[34]

**The organization of facts in history and natural history**

History was generally left out of Renaissance educational curricula because it was considered not complex enough to require instruction and too bulky to include.[35] But history, human and natural, offers a rich field in which to study how Renaissance scholars organized increasing quantities of material, in collections of specimens and manuscript notes and above all voluminous printed books. Human history was one of the disciplines favored by the humanists who viewed it as a source of examples of past errors and successes which could usefully inform the political and ethical decisions of their day.[36] Humanism fueled a special interest in ancient history, but medieval and contemporary histories were also printed in great numbers. Interest in history spawned a new genre offering advice about how to read and to write books of history.[37] In his Method for the easy comprehension of history (1566), for example, Jean Bodin recommended flagging in the margins of history books actions which proved useful or not and honorable or not so that one could easily find cases to guide one's own behavior. Passages annotated in the way Bodin recommended could also be copied out into a notebook under the appropriate heading (e.g. "useful and dishonorable actions," "useless and dishonorable" ones, or other topical headings) under which they could be retrieved again. This practice of note-taking fueled the publication of compilations of historical exempla which promised to offer all the rewards of history-reading--memorable passages distilled from hundreds of histories--without the effort of reading the sources directly. The largest of these compilations reached thousands of folio pages filled with historical anecdotes selected as exemplary in some way; most collections of exempla and apophthegms were shorter, but faced on a lesser scale the same problems of selection, heading assignment and arrangement.

Natural history also experienced unusually rapid growth during the Renaissance, stimulated

at first by humanist attempts to identify the plants and animals named in the recently recovered treatises of natural history by classical authors, and further expanded by the many new species reported by travellers to the new world as well as exotic parts of the old world. The number of known plants exploded from the 500 listed in the natural history of Dioscorides who ranked as the greatest botanical authority in 1550 to some 6000 plants cataloged by Caspar Bauhin in 1623.[38]

Renaissance scholars faced an unprecedented growth of content in these fields, largely through the accumulation of discrete chunks of information (similar in many ways to what we call "facts"), but the methods they deployed to organize all that material were medieval in origin.[39] Selecting or summarizing from textual sources and sorting and storing these passages under topical headings constituted the basic operations underlying medieval florilegia and the compendia conventionally called "medieval encyclopedias." The size and sophistication of these collections increased in the 13th century, during an earlier period of knowledge explosion, thanks to new practices of alphabetization (starting with the biblical concordances of the 13th century, then spreading to alphabetical indexes for many kinds of texts) and textual layout which facilitated reading by consultation rather than straight through. The use of different sizes of script, of running heads, rubrication and numbered sections and subdivisions was typical of scholastic as opposed to monastic manuscripts.[40] Collections of historical material in print experimented with new techniques (e.g. dingbats, different fonts and formats, greater use of centering and blank space) to increase the consultability of volumes which became steadily larger in size without, thanks to printing, becoming prohibitive in price.[41]

The assignment of a passage to a topical heading under which it could later be retrieved remained unchanged as the primary strategy for information management in the Renaissance, both in the commonplace notes that pupils in humanist schools were trained to take on their reading, and in the printed compendia which offered ready-made the kinds of notes Renaissance users would

have wanted to have taken themselves.[42] The personal judgment of the note-taker or compiler governed the selection of the authors and texts to excerpt and of the particular passages copied out (and sometimes tacitly rephrased in the process), then of the heading under which to file each passage. The arrangement of the headings in the collection (and to a much lesser extent of the passages within a heading) was also decided by the compiler. In manuscript collections headings were generally formed in the order in which they occurred to the note-taker in the course of reading, whatever the sequence of texts; manuscript notes almost never discussed the arrangement of headings. In print Renaissance compilers often did justify their choice of organizational scheme from among the three principal options of miscellaneous, alphabetical or systematic arrangements.

The self-consciously miscellaneous order found in a number of Renaissance compilations was without medieval antecedent; the authors of miscellanies invoked the model of Aulus Gellius who claimed to have composed his Attic Nights in the order in which he read texts and made observations on them. Miscellaneous order was probably rarely due to simple happenstance and often betrayed loose topical associations.[43] Nonetheless various miscellanies proclaimed that a fortuitous arrangement added variety to the pleasure of reading. Typically one or more alphabetical indexes appended to the miscellaneous text made the material accessible to the user in search of a specific topic.[44] An alphabetical order of headings was common in medieval florilegia and perpetuated in many Renaissance collections of quotations and anecdotes; it offered the greatest ease of use, but was criticized for being dictated by the arbitrariness of "grammar." A systematic order on the contrary promised conceptual beauty in matching the order of things.[45]

Renaissance encyclopedic works featured many different systematic schemes, from the chain of being to the decalog.[46] Some purported to facilitate memorization; others strove for pansophy, or the wisdom that comes from knowing all things and their interconnections.[47] Large-sized printed compilations typically featured one or more alphabetical indexes which allowed for an

alternative mode of access.[48] This was the case for one of the most elaborately classified compilations, the Theatrum humanae vitae (1565) in which Theodor Zwinger gathered historical exempla on a grand scale under topical headings with multiple layers of sections and subsections carefully arranged (and rearranged in two subsequent editions published in his lifetime) according to elaborate Ramist diagrams.[49] Zwinger prided himself on devising an order which was not chronological, but "rhapsodic," as he called it, designed to highlight the ethical value of his material, which he sorted broadly by vices and virtues. That Zwinger's systematic order proved effective for users is doubtful; one contemporary commented that it was difficult to find anything in Zwinger's Theatrum except through the index.[50] The work was indeed published with an increasing number of alphabetical indexes, by topical heading first, then by proper names and "memorable words and things" (cf. our notion of "keyword"). In enlarging on Zwinger's Theatrum in his magnum theatrum of 1631 Beyerlinck resorted to alphabetizing the major headings, noting that "many approved little of the systematic order for history."[51]

Natural historians grappled with similar tensions between the ideal of a system which would represent faithfully the complexity and hierarchy of nature and the practicalities of retrieving information in large-scale compilations. Renaissance natural history is well known for its lack of a "scientific classification"--modern classifications were introduced in the 18th century for both plants and animals (e.g. by Linnaeus and Cuvier among others). Renaissance classifications of plants and animals used categories formed in antiquity (by Aristotle, Theophrastus and Dioscorides especially), based on common experience: tree, shrub, undershrub and herb; quadrupeds, reptiles, fish, and birds. Subdivisions within these broad categories varied with different authors. Ulisse Aldrovandi, who studiously avoided any use of alphabetical order as merely grammatical and arbitrary, sorted birds in his 3-volume Ornithologiae according to their habits and habitats (in three main categories: birds of prey, birds that roll in the dust, birds that live on or near water), then according to specific

physical features (similarities in beaks, feathers etc).[52] Similarly, in botany, "small-scale" groupings of similar plant types were juxtaposed with one another rather arbitrarily.[53]

Alphabetical order had already been used for listing plants and animals in compendia starting in the 13th century.[54] In the 16th natural historians who opted for alphabetization acknowledged the arbitrariness of "grammatical order," but explained its virtues, as Conrad Gesner did in the preface to his four folio volume Historiae Animalium: "the utility of lexica [like his] comes ... not from reading them from beginning to end, which would be more tedious than useful, but from consulting it from time to time."[55] By referring to his natural histories as lexica, Gesner highlighted their similarity to the genres focused on organizing words and books for which alphabetical order was common (though not universal). Although Gesner's natural histories were widely respected and his choice of alphabetical order was imitated by some, many continued to search for the perfect systematic order. During the 1620s Federico Cesi developed detailed plans for a "theater of nature" which would represent the reality of nature in all its complex relationships, but the plans were never implemented beyond printing a few diagrams and constituting a large collection of exquisite drawings from nature.[56] Caspar Bauhin took a more pragmatic approach in listing thousands of kinds of plants, with references to the authors who described them; Bauhin offered no charts nor even a table of contents outlining the order he followed--the work is accesible primarily through the alphabetical index.[57]

**The organization of objects**

After considering theoretical classifications of the disciplines and the arrangements of textual excerpts in historical compilations, I will turn briefly to the organization in Renaissance collections of physical objects of different kinds, from natural specimens to books. However, these collections (even in libraries) have not been preserved with their Renaissance ordering undisturbed,

so that our evidence for them is indirect, frmo representations of the collections in images or through written inventories and catalogs.

Cabinets of curiosities brought together the widest array of objects, from unicorn horns (narwhal tusks) to American bows and exquisitely crafted gemstones. Judging from the images we have of these collections, the physical constraints of the objects and the display space (usually a single room) often dictated a rather haphazard physical arrangement.[58] Given the expenses and difficulties of amassing such collections, most were not very large and did not require extensive organization for pragmatic reasons. But in manuscript and printed inventories owners generally grouped their objects according to basic categories, notably in sections for naturalia and artificialia, each with further subdivisions, e.g. for minerals, plants, shells, medals and paintings. Within each section the items were not clearly ordered, though the most significant and costly items in a section would typically be listed first.[59] The most sophisticated inventories, notably of the lavish Kunstkammern at Ambras and Prague in the Holy Roman Empire, added a category of scientifica for instruments of scientific observation and emphasized a hierarchy of materials, from specimens in their unadorned natural state to those which blended nature and art, culminating in those which displayed the greatest level of human artistry.[60] Distinct from cabinets of curiosities, with their encyclopedic scope and often symbolic significance, were the collections of natural specimens gathered and organized for practical or pedagogical purposes in markets, homes, gardens, laboratories and anatomy theaters--all of which sites of knowledge have recently started to garner scholarly attention.[61]

Collections of coins and epigraphs stimulated by humanist interest in antiquity also required organization, especially since they reached much larger proportions than most cabinets of curiosities--coins were small and not yet very expensive and epigraphs were recorded by copying out (though some collected the stone inscriptions when they could). Coins could be sorted (at least

in the books describing them--the actual order of the collection is generally not known) by emperor, time and place, by size, by metal, by tails or heads.[62] A massive collection of epigraphs by Jan Gruter was organized in 20 classes by author of inscription and published with 24 alphabetical indexes produced by Joseph Scaliger according to a variety of criteria (interesting words used, temples at which they were found, professions or family members mentioned, among others).[63]

The most widely used and collected objects were books. Personal libraries increased over tenfold in size from 1450 to 1650 as a result of the lower cost, greater availability and increasing accumulation of printed books.[64] Most personal collections were not cataloged--we know of them through inventories after death which were often arranged in order of decreasing commercial value. Institutional libraries typically maintained more or less sophisticated inventories for internal use (to record the movement of books acquired, lost, traded or lent out), so that a formal catalog was not always produced. Examples of library catalogs arranged by author and/or subject (and even one union catalog covering the holdings of multiple monasteries) existed in the middle ages.[65] But the genre developed much more in the Renaissance: libraries were increasingly open to users beyond in-house residents of a college or monastery; printed catalogs were useful to attract patronage or boost reputation. The first printed catalog was that of the Bodleian (1605); interleaved and annotated copies of this printed catalog were also used as catalogs by other libraries.

Sales catalogs appeared soon after printing to aid in attracting buyers for new imprints. Used books were also traded, though we have little information about this trade, except through the practice of auctioning larger book collections which began in the Low Countries in the late 16th century. Catalogs of books for sale (auction and booksellers' catalogs) generally observed practical considerations of use and storage in addition to basic disciplinary divisions: books were sorted into size (folio, quarto, octavo) and languages (Latin and the separate vernaculars). These catalogs typically started with the largest (and most expensive) items and moved from the most prestigious

disciplines to the newer, smaller fields--from theology, law, and medicine to mathematics and poetry. Within each section (broken down by discipline, size and language) there were not too many books to list them in random order.[66]

Library catalogs on the other hand were generally produced only for the largest libraries and were therefore considerably longer and made greater use of alphabetical lists by author--either in a single alphabetical list, or, as in the case of the Bodleian catalog of 1605 within sections for each of the disciplines. Subject indexes to the lists of authors were rare and dependent on the diligence of the librarian who was often also charged with many other tasks.[67] Whether printed or manuscript, Renaissance library catalogs were drawn up with few provisions for new additions--catalogs did not take the form of moveable slips before at least the 18th century, although slips were sometimes used in the process of alphabetizing and could even be glued onto sheets to form the catalog itself.[68] Typically catalogs grew by annotation for a time, then a new catalog was made to supersede the old.

The bibliography was another essential tool for managing the knowledge of books in the Renaissance since it listed books beyond any single collection and could include even authors by whom little or nothing was actually extant. Conrad Gesner's attempt at an exhaustive listing of all authors and works in Greek, Latin and Hebrew in his Bibliotheca universalis (1545) far surpassed in scope and ambition the few medieval contributions to the genre.[69] Gesner arranged the material in a single alphabetized list of authors but planned to add a topical index to all their works; though this plan was not fully carried out, Gesner did publish an associated volume (the Pandectae, 1548) which listed the relevant books and sections of books by discipline and topical subheadings.[70] Gesner favored alphabetical order as facilitating consultation, but the first bibliographer of French vernacular books articulated a further virtue of alphabetical order when dealing with living authors. La Croix du Maine explained that he would order his collection of treatises on the noble houses of

France by "the order of a,b,c, ... so as to anger no one," as he would if he attempted a hierarchical order.[71] The use of alphabetical order in the Renaissance should not be interpreted as a rejection of social or intellectual hierarchies, but it presented pragmatic advantages for the reader as well as the author, in sparing them the difficulties of ordering information according to an increasingly complex understanding of reality.

**In summary**

During the Renaissance institutions often did not seem to change much. Old universities were governed by medieval statutes and served as the models for the many new foundations; only a few schools were designed to institutionalize the humanist disciplines, such as the trilingual colleges in Louvain (1517) and Paris (1530). Academies were only just beginning to offer durable alternative sites for intellectual work (e.g. Accademia del Disegno, 1561; Accademia dei Lincei, 1603; Académie française, 1630). Though it was an increasingly eclectic Aristotelianism, Aristotelianism continued to dominate university teaching (until the 1690s in Paris for example).[72] At the same time the Renaissance was a period of great intellectual and cultural ferment: printing, humanism and new discoveries stimulated new areas of study and the accumulation of much new material. History and natural history grew especially fast, despite minimal institutional support, by appealing to the interests of a broadening educated elite: examples from human history would improve current political and ethical decisions and the collection of natural historical specimens and descriptions would promote a greater appreciation of God's creation and the potential for better mastery of it (notably in medicine and pharmacy). Activities once considered artisanal and mechanical acquired new status from court patronage and from the introduction of mathematical techniques (whether successful or only prospective). The proliferation of books fueled the growth of compilations which offered the best selections from all those books one didn't have money to buy or time to read

oneself, as well as increasingly sophisticated library and sales catalogs.

Many of the structures used for organizing knowledge in the Renaissance--the hierarchical classification of the disciplines, the use of headings to sort and store material, and the use of alphabetical order in texts, indexes and catalogs--were inherited from the middle ages. But these structures were expanded and transformed during the Renaissance as they accommodated new fields of study and massive quantities of new material. Renaissance authors experimented with different classifications of the disciplines and many kinds of order, from the miscellaneous to the systematic. Alphabetical order, already prevalent in dictionaries, bibliographies and many florilegia in the middle ages, appeared increasingly in other genres too during the Renaissance: in library catalogs, some natural histories and as an index to improve the useability of miscellaneously or systematically arranged compilations. But the dominance of alphabetical order which persisted until recently (until the rise of electronic media) began only in the late seventeenth century. The organization of knowledge in the Renaissance took many forms, often complex and original, which warrant further study at the intersections of the cultural history and the history of the book with intellectual history and the history of philosophy.

NOTES

I am grateful for excellent suggestions to Mordechai Feingold, Anthony Grafton, James Hankins and Nancy Siraisi.

1.For some discussion of the meanings of the "organization of knowledge," see Henry Evelyn Bliss, The Organization of Knowledge and the System of the Sciences (New York: Henry Holt, 1929), ch. 4.
For the best entries into the topic, see Peter Burke, A Social History of Knowledge from Diderot to Gutenberg (Cambridge: Polity Press, 2000), esp. ch. 5 and The Shapes of Knowledge from the Renaissance to the Enlightenment, ed. Donald Kelley and Richard Popkin (Dordrecht: Kluwer, 1991); for a somewhat later period, see Lorraine J. Daston, "Classifications of Knowledge in the Age of Louis XIV," in Sun King: the Ascendancy of French Culture during the Reign of Louis XIV, ed. David Lee Rubin (Washington DC: Folger Shakespeare Library, 1992), 207-20.

2.For a philosophical approach see Jean Piaget, "Le système et la classification des sciences," in his Logique et connaissance scientifique (Paris: Gallimard, 1967). Levi-Strauss interpreted classification as an attempt to control of the world in La pensée sauvage (Paris: Plon, 1962). For a sophisticated interdisciplinary approach see Geoffrey C. Bowker and Susan Leigh Star, Sorting things out. Classification and its Consequences (Cambridge, Mass: MIT Press, 1999).

3.On this point and 18th-century classifications more generally, see Richard Yeo, "Classifying the Sciences" in Cambridge History of Science, vol. 4: Eighteenth-Century Science, ed. Roy Porter (Cambridge: Cambridge University Press, 2003), 241-66, p. 248; Giorgio Tonelli, "The Problem of the Classification of the Sciences in Kant's Time," in Rivista Critica di Storia della Filosofia 30 (1975), 243-94, e.g. p. 265.

4.Still useful is the general historical overview by Robert Flint, Philosophy as scientia scientiarum and a history of classifications of the sciences (New York: Arno Press, 1975; first published 1904); see also The Structure of Knowledge: Classifications of Science and Learning since the Renaissance, ed. Tore Frängsmyr (Berkeley, CA: Office for History of Science and Technology, 2001).

5.For the tripartition see Topics VI, 6, 145a15; for allusions to bipartition see Topics VII, 1 and Metaphysics I, 1 and VI, 1. For further references to Aristotle and discussion see Joseph Mariétan, Problème de la classification des sciences d'Aristote à St-Thomas (St-Maurice, Valais, Switzerland: Imprimerie St-Augustin and Paris: Félix Alcan, 1901), ch. 1. For a discussion of how Aristotle's tripartite division of speculative philosophy was indebted to Plato's tripartition of being, see Philip Merlan, From Platonism to Neo-Platonism (The Hague: Nijhoff, 1953), 59-87.

6.On the Stoic tripartite division of philosophy, see Michael J. White, "Stoic Natural Philosophy," in Cambridge Companion to the Stoics, ed. Brad Inwood (Cambridge: Cambridge University Press, 2003), p. 124. On the attribution of a tripartite classification of philosophy to Plato by Sextus Empiricus, see Flint, p. 70 (citing Adversus Mathematicos VII, 16); on Augustine's role in this attribution, see Monique Paulmier-Foucart, avec la collaboration de Marie-Christine Duchenne, Vincent de Beauvais et le grand miroir du monde (Brepols, 2004), p. 229, citing De civitate dei, VIII, 4.

7.My discussion of medieval classifications is especially indebted to James Weisheipl, "Classification of the Sciences in Medieval Thought," Medieval Studies 27 (1965), 54-90 and "The Nature, Scope and Classification of the Sciences" in Science in the Middle Ages, ed. David C. Lindberg (Chicago: University of Chicago Press, 1977), 461-82. Augustine was suspicious of astronomy (De doctrina Christiana, II, 29) but planned a disciplinarum libri on all seven liberal arts; see Weisheipl, "Medieval classification," p. 57.

8.See Weisheipl, "Medieval Classification," pp. 58-65 for diagrams and more detailed discussion of the primary sources: Boethius, In Isagogen Porphryii Commentarii; Cassiodorus, Institutiones [II, 3, 4] and Isidore, Etymologiae [II, 24,1].

9.Hugh of St Victor, Didascalicon, I, 4-11. See more generally Elspeth Whitney, Paradise Restored: the mechanical arts from antiquity through the thirteenth century (Philadelphia: American Philosophical Society, 1990).

10.Weisheipl, "The Nature, Scope and Classification of the Sciences," p. 475. See also Gilbert Dahan, "Les classifications du savoir aux XIIe et XIIIe siècles," L'enseignement philosophique 40 (1990), 5-27; studies of specific classifications include Nicholas H. Steneck: "A Late Medieval Arbor Scientiarum" Speculum 50 (1975): 245-69 and Cora Lutz, "Remigius' ideas on the classificiation of the seven liberal arts," Traditio 12 (1956), pp. 65-86.

11.Weisheipl, "Medieval Classification," p. 475. On Arabic classifications including al-Farabi's 5-fold division of the sciences (into sciences of language, logic, mathematics, physics and politics), see J. Jolivet, "Classification des sciences," in Histoire des sciences arabes, ed. Roshdi Rashed (Paris: Editions du Seuil, 1977), vol. 3, pp. 255-70.

12.Vincent offers excerpts on classification by Isidore of Seville, Hugh of Saint-Victor, Richard of Saint-Victor, Michael Scot, Aristotle, al-Farabi, Avicebron, and Augustine. Vincent of Beauvais, Speculum doctrinale, book I, chs. 14-18, available in French translation in Monique Paulmier-Foucart, Vincent de Beauvais et le grand miroir du monde, pp. 231-37.

13.On Aristotle's ideas on this point, see Mariétan, pp. 30ff. On the emergence of the notion of "scientia media" in the middle ages (notably with Thomas Aquinas), see Jean Gagné, "Du

quadrivium aux scientiae mediae," Arts libéraux et philosophie au moyen âge, Actes du Quatirème colloque international de philosphie médiévale (Montreal: Institut d'études médiévales and Paris: Vrin, 1969), pp. 975-86.

14.These Platonizing scholastics included Robert Grosseteste, Roger Bacon and Robert Kilwardby; see Science in the Middle Ages, pp. 477-78.

15.Two examples are cited in the literature: Ficino translated work by the Greek Albinos, a Platonic-eclectic author of the mid-2nd century, who proposed a synthesis between the Aristotelian and the Platonic/Stoic classifications; see Grazia Tonelli Olivieri, "Galen and Francis Bacon: Faculties of the Soul and the Classification of Knowledge," in The Shapes of Knowledge from the Renaissance to the Enlightenment (Dordrecht: Kluwer, 1991), pp. 61-81, note 69, p. 80. Geminus of Rhodes developed the category of "sensible mathematics" as a more inclusive category than Aristotle's "mixed" sciences; excerpts from Geminus were printed and translated in the Renaissance in Proclus' Sphaera (ca. 1522). On Geminus and his influence, see Jean-Marc Mandosio, "Entre mathématiques et physique: note sur les 'sciences intermédiaires' à la Renaissance," in Comprendre et maîtriser la nature au Moyen âge. Mélanges d'histoire des sciences offerts à Guy Beaujouan [no editor] (Geneva: Droz, 1994), pp. 115-38.

16.His classification is ultimately quite familiar, tripartite (theoretical, practical and logical), with careful attention to mathematics and to the seven mechanical arts (from Hugh of Saint-Victor). See Jean-Marc Mandosio, "La classification des sciences et des arts (XVe-XVIIe siècles)," Nouvelle Revue du Seizième Siècle 20/1 (2002), pp. 19-30, and "Les sources antiques de la classification des sciences et des arts à la Renaissance," in Les voies de la science grecque, ed. Danielle Jacquart (Geneva: Droz, 1997), pp. 331-90. On the fortuna of this text and its reuse by other authors in 16th-century France, see Jean-Marc Mandosio, "La fortune du Panepistemon d'Ange Politien en France au XVIe siècle," in La réception des écrits italiens en France à la Renaissance: ouvrages philosophiques, scientifiques et techniques (Paris: Université de Paris III, 2000), pp. 49-71. See also Ida Maïer, "Un inédit de Politien: la classification des "arts," Bibliothèque d'Humanisme et Renaissance 22 (1960), pp. 338-55. For another humanist classification, see Jean-Marc Mandosio, "La classification des sciences et des arts chez Alberti," in Leon Battista Alberti: actes du congrès international de Paris (Paris: Vrin, 2000), pp. 643-704.

17.On the rise of the mechanical arts, see Paolo Rossi, Philosophy, technology and the arts in the early modern era, tr. Salvator Attanasio, ed. Benjamin Nelson (New York: Harper and Row, 1970).

18.Paul Oskar Kristeller, "The modern system of the arts," Journal of the History of Ideas 12 (1951), pp. 496-527; for the Renaissance period see Claire Farago, "The Classification of the Visual Arts in the Renaissance," in The Shapes of Knowledge, pp. 23-48.

19.See Paul L. Rose, The Italian Renaissance of Mathematics (Geneva: Droz, 1975); on the parallel

role of occultists like Agrippa of Nettesheim in promoting mathematical sciences, see Anthony Grafton, "Technica curiosa: Technology and Magic in Early Modern Europe," a lecture delivered Oct. 23, 2002 and available at www.princeton.edu/WebMedia/Lectures.

20.See Dee's preface in Euclid, The Elements of Geometrie, tr. H. Billingsley (London: John Daye, 1570), [p. 1-50]. Also availble in John Dee, The Mathematicall Preface to the Elements of Geometrie of Euclid of Megara (1570), ed. Allen G. Debus (New York: Science History Publications, 1975).

21.Richard Tuck, "The institutional setting," in The Cambridge History of Seventeenth-Century Philosphy, ed. Daniel Garber and Michael Ayers (Cambridge: Cambridge University Press, 1998), I, 9-32, pp. 17-19.

22.Roger Ariew, "Christopher Clavius and the classification of sciences," Synthèse 83 (1990), 293-300.

23.Heikki Mikkeli, "The foundation of an autonomous natural philosophy: Zabarella on the classification of arts and sciences," in Method and Order in Renaissance Philosophy of Nature. The Aristotle Commentary Tradition, ed Daniel Di Liscia, Eckhard Kessler, Charlotte Methuen (Aldershot, Hampshire: Ashgate, 1997). p. 211-28.

24.Charles Lohr, "The sixteenth-century transformation of the Aristotelian division of the speculative sciences," in The Shapes of Knowledge, pp. 49-58 + "Metaphysics," in The Cambridge History of Renaissance Philosophy, ed. Charles Schmitt et al. (Cambridge: Cambridge University Press, 1988), pp. 537-638. On Spanish classifications more generally see Helmut Jacobs, Divisiones philosophiae: Spanische Klassificationen der Künste und Wissenschafter im Mittelalter und Siglo de Oro (Frankfurt am Main: Vervuert Verlag, 1996).

25.See Joseph Freedman, "Classifications of Philosophy, the Sciences and the Arts in Sixteenth- and Seventeenth-century Europe," Modern Schoolman 72 (1994), 37-65, esp. pp. 51-56 for a number of diagrams of specific systems.

26.The best account of Ramus remains Walter J. Ong, Ramus: Method and the Decay of Dialogue (Chicago: University of Chicago Press, 2004; first published 1958), pp. 43-44 on the role of Plato in Ramus' thought.

27.See The Influence of Petrus Ramus: studies in sixteenth and seventeenth century philosophy and sciences, ed. Mordechai Feingold, Joseph S. Freedman and Wolfgang Rother (Basel: Schwabe, 2001).

28.Neal Gilbert, Renaissance concepts of method (New York: Columbia University Press, 1960); also William F. Edwards, "Niccolò Leoniceno and the Origins of Humanist Discussion of Method,"

in Philosophy and Humanism. Renaissance Essays in Honor of Paul Oskar Kristeller (New York: Columbia University Press, 1976), pp. 283-305.

29.Ong, Ramus, pp. 74-91. For antecedents to Ramus' use of dichotomous diagrams see also John Murdoch, Antiquity and the Middle Ages, Album of Science (New York: Scribner, 1984) and K. J. Höltgen, "Synoptische Tabellen in der medizinischen Literatur und die Logik Agricolas und Ramus," Sudhoffs Archiv 49 (1965): 371-90.

30.Christofle de Savigny, Tableaux accomplis de tous les arts libéraux (Paris: Jean and François de Gourmont, 1587); on this point, see Burke, A social history of knowledge, pp. 97-98.

31.Tonelli Olivieri, "Galen and Francis Bacon."

32.Sachiko Kusukawa, "Bacon's Classification of Knowledge," in The Cambridge Companion to Bacon, ed. Markku Peltonen (Cambridge: Cambridge University Press, 1996), pp. 47-74.

33.On Alsted's strategies of harmonization, see Howard Hotson, Johann Heinrich Alsted 1588-1638: between Renaissance, Reformation and universal reform (Oxford: Clarendon Press, 2000); and Ann Blair, "Mosaic Physics and the Search for a Pious Natural Philosophy in the Late Renaissance," Isis 91 (2000), 32-58, p. 54-56.

34.Notably as "dictionaries of the arts and sciences"; see Richard Yeo, Enlightenment Visions: Scientific Dictionaries and Enlightenment Culture (Cambridge: Cambridge University Press, 2001).

35.Gilbert Jacchaeus (1635) as quoted in Ann Blair, The Theater of Nature: Jean Bodin and Renaissance Science (Princeton: Princeton University Press, 1997), p. 35. In Renaissance classifications history was variously defined narrowly as human history or broadly as human and natural history; on these interactions see Jean-Marc Mandosio, "L'histoire dans la classification des sciences et des arts à la Renaissance," Corpus 28 (1995), pp. 43-72 and Historia: empiricism and erudition in early modern Europe, ed. Gianna Pomata and Nancy Siraisi (Cambridge, Mass.: MIT Press, 2005).

36.On exemplar history see George H. Nadel, "Philosophy of History before Historicism," History and Theory 3 (1964), pp. 291-315.

37.Anthony Grafton on ars historica, forthcoming

38.See Brian W. Ogilvie, "Encyclopaedism in Renaissance botany: from historia to pinax," in Pre-modern encyclopaedic texts. Proceedings of the second COMERS Congress, Groningen, 1-4 July 1996, ed. Peter Binkley (Leiden: Brill, 1997), p. 89-99.

39.For an entry into the recent historiography on the rise of the notion of "fact" in the early modern

period, see Ann Blair, "Historia in Theodor Zwinger's Theatrum humanae vitae," in Historia: Empiricism and Erudition in Early Modern Europe, ed. Gianna Pomata and Nancy Siraisi (Cambridge, Mass.: MIT Press, 2005), pp. 269-96, pp. 283ff and Lorraine Daston, "Perché i fatti sono brevi?" in Fatti: storie dell'evidenza empirica, ed. Simona Cerutti and Gianna Pomata, special issue of Quaderni storici 108 (2001), 745-70. On the problem of overload more generally see Ann Blair, "Reading Strategies for Coping with Information Overload, ca. 1550-1700," Journal of the History of Ideas 64 (2003), pp. 11-28.

40.For an introduction to their many studies on scholastic tools and ordinatio see Mary Rouse and Richard Rouse, Authentic Witnesses: Approaches to Medieval Texts and Manuscripts (Notre Dame, IN: University of Notre Dame Press, 1991), esp. chs. 4-7.

41.Medieval florilegia were often brief, whereas the most widely printed Renaissance florilegium, Domenico Nanni Mirabelli's Polyanthea started at ca. 500,000 words and grew in successive editions to about 3 million words by 1600. The all-time largest encyclopedia of the middle ages, Vincent of Beauvais' Speculum maius weighed in at about 3 million words, while its late Renaissance equivalent, Laurentius Beyerlink's Magnum theatrum (1631) reached 15 million words. Although these very large reference books were of course very expensive relative to smaller books, the cheapening of book production by printing made it feasible to produce and market such large works.

42.For an entry into the considerable literature on commonplacing see Ann Moss, Printed commonplace-books and the structuring of Renaissance thought (Oxford: Clarendon, 1996) and Ann Blair, "Humanist Methods in Natural Philosophy: the Commonplace Book," Journal of the History of Ideas 53 (1992), 541-551 and on note-taking more generally, "Note-Taking as an Art of Transmission," Critical Inquiry 31 (2004), pp. 85-107. On marginal annotation, see Talking to the Text: Marginalia from Papyri to Print, Proceedings of a Conference held at Erice in 1998 as the 12th Course of the International School for the Study of Written Records, ed. Vincenzo Fera, Giacomo Ferraù and Silvia Rizzo, 2 vols (Messina: Centro interdipartmentale di Studi umanistici, 2002).

43.This point is made convincingly about Gellius' arrangement for example in Leofranc Holford-Strevens, Aulus Gellius. An Antonine scholar and his achievement (Oxford: Oxford University Press, 2003), pp. 30-36.

44.On the virtues of miscellaneous order see Angelo Poliziano, Miscellaneorum centuria prima (Basel: V. Curio, 1522), preface. On the genre of the miscellaneously arranged commentary see Ann Blair, "The Collective Commentary as a Reference Genre," in Der Kommentar in der Frühen Neuzeit, ed. Ralph Häfner and Markus Völkel (Tübingen: Max Niemeyer Verlag, 2006), pp. 115-31. On the relation of Renaissance commentary to ancient and medieval commentaries, see On Renaissance Commentaries, ed. Marianne Pade, Noctes Neolatinae: Neo-Latin Texts and Studies, Band 4 (Hildesheim: Olms, 2005).

45.See the tag "nothing is more beautiful than order," as in Olivier Fatio, Nihil pulchrius ordine. Contribution à l'établissement de la discipline ecclésiastique aux Pays-Bas ou Lambert Daneau aux Pays-Bas (1581-83) (Geneva: Droz, 1971).

46.See, respectively, Girolamo Cardano, De subtilitate (1551), Andreas Hondorff, Promptuarium exemplorum (1572) as discussed, among over a dozen different kinds of systematic orders, in Paul Michel, "Ordnungen des Wissens. Darbietungsweisen des Materials in Enzyklopädien," in Populäre Enzyklopädien. Von der Auswahl, Ordnung and Vermittlung des Wissens, ed. Ingrid Tomkowiak, Chronos, pp. 35-83, at pp. 46, 58.

47.Most famously Giulio Camillo Delminio designed a "theater of memory" as a physical space in which one could enter to contemplate an ordered display of all knowledge; on his program and its context and impact see Lina Bolzoni, The Gallery of Memory. Literary and Iconographic Models in the Age of the Printing Press, tr. Jeremy Parzen (Toronto: University of Toronto Press, 2001). For a rich survey of pansophic writing, see Wilhelm Schmidt-Biggemann, Topica universalis: eine Modellgeschichte humanistischer und barocker Wissenschaft (Hamburg: Meiner, 1983).

48.On Renaissance indexing see Ann Blair, "Annotating and indexing natural philosophy," in Books and the Sciences in History, ed. Marina Frasca-Spada and Nick Jardine (Cambridge: Cambridge University Press, 2000), pp. 69-89.

49.Theodor Zwinger, Theatrum Vitae Humanae (Basel: Oporinus and Froben brothers, 1565), with ever larger reeditions in 1571 and 1586 and a posthumous reprinting (with an additional index) in 1604.

50.Bartholomaeus Keckermann, "Consilium logicum de adornandis et colligendis locis communibus, rerum et verborum," in Opera omnia (Geneva: Petrus Aubertus, 1614), vol. 2, p. 220-40, p. 224 (misprinted as p. 210).

51.Laurentius Beyerlinck, Magnum theatrum vitae humanae (Lyon: Huguetan and Ravaud, 1666), sig. [e3]v; this preface is not present in the edition of 1631, though the shift to alphabetical had been made. Nonetheless, the articles in Beyerlinck were often very long ("Bellum" runs to 106pp) and maintained Zwinger's subdivisions within them.

52.For an excerpt in translation, see Aldrovandi on Chickens: the Ornithology of Ulisse Aldrovandi (1600), vol. II, book XIV, tr. L. R. Lind (Norman, OK: University of Oklahoma Press, 1963); see more generally J. J. Hall, "The Classification of Birds, in Aristotle and Early Modern Naturalists," History of Science 29 (1991), pp. 111-51 and 224-43. On Aldrovandi's organizational practices, which included drawing up hierarchical tables to accompany his collection of natural historical specimens, see Paula Findlen, Possessing Nature: Museums, Collecting and Scientific Culture in Early Modern Italy (Berkeley: University of California Press, 1994), pp. 60-62.

53.Ogilvie calls these groupings "pre-theoretical"; Brian Ogilvie, The Science of Describing: Natural History in Renaissnce Europe (Chicago: University of Chicago Press, 2006), pp. 218-19.

54.Christian Hünemörder, "Aims and intentions of botanical and zoological classification in the Middle Ages and Renaissance," History and Philosophy of the Life Science 5 (1983), pp. 53-67.

55.Conrad Gesner, Historiae Animalium lib. I de Quadrupedibus viviparis (Zurich: Froschauer, 1551), sig. beta 1v.

56.See David Freedberg, The Eye of the Lynx. Galileo, his Friends and the Beginnings of Modern Natural History (Chicago: University of Chicago Press, 2002). On the use of tables and grids in natural history, see Claudia Swan, "From Blowfish to Flower Still Life Paintings: Classification and its Images circa 1600," in Merchants and Marvels: commerce, science and art in early modern Europe. ed. Pamela Smith and Paula Findlen (New York: Routledge, 2002), 109-36. A grid-like layout of natural specimens in a box with 6 X 6 pigeonholes called a pantotheca is described in the opening pages of the "Colloquium heptaplomeres" traditionally ascribed to Jean Bodin (ca. 1590); see Marion Leathers Kuntz tr., Colloquium of the seven about the secrets of the sublime (Princeton NJ: Princeton University Press, 1975), pp. ??

57.Caspar Bauhin, Pinax theatri botanici (Basel: L. König, 1623).

58.For some examples see Paula Findlen, Possessing Nature, esp. ch. 3. Michele Mercati's cabinets for arranging metals constitute a rare case in which the physical arrangement matched a conceptual one. The plates of Mercati's Metallotheca were made in 1580 but printed only in 1717; see Alix Cooper, "The museum and the book: the 'Metallotheca' and the history of an encyclopaedic natural history in early modern Italy," Journal of the History of Collections 7 (1995), 1-23.

59.For an example see Pierre Trichet, Synopsis rerum variarum tam naturalium quam artificialium (n.pl., n.d. [Bordeaux, c. 1635]).

60.On this interpretation of the Kunstkammer as a celebration of Promethean ambitions (notably in automata), see Horst Bredekamp, The Lure of Antiquity and the Cult of the Machine. The Kunstkammer and the Evolution of Nature, Art and Technology, tr. Allison Brown (Princeton: Markus Wiener Publishers, 1995). In a work which became an important model for the Habsburg inventories, though it was an abstract classification associated with no real collection, Samuel Quiccheberg offered a five-fold division of a Kunstkammer into objects pertaining to the ruler and his realm, arts and crafts, natural specimens, artificialia and paintings; for a modern edition and German translation of this work of 1565 see Der Anfang der Museumslehre in Deutschland: das Traktat "Inscriptiones, vel, Tituli Theatri Amplissimi von Samuel Quiccheberg: latein-deutsch, ed. and tr. Harriet Roth (Berlin: Akademie Verlag, 2000).

61.See Paula Findlen, "Building the house of knowledge: The structures of thought in late Renaissance Europe," in The Structure of Knowledge, pp. 5-51 and Katharine Park and Lorraine Daston, The Cambridge History of Science, vol. 3: Early Modern Science (Cambridge: Cambridge University Press, 2006), chs. 8-9, 12-13. On the symbolic role of cabinets of curiosities, see Krzysztof Pomian, Collectors and curiosities: Paris and Venice 1500-1800, tr. Elizabeth Wiles-Portier (Cambridge: Polity Press, 1990).

62.On collections of medals see Antoine Schnapper, Le Géant, la licorne, la tulipe: collections françaises au XVIIe siècle (Paris: Flammarion, 1988), pp. 133ff. I am also grateful to Brian Ogilvie for expert advice on this point.

63.Jan Gruter, Inscriptiones antiquae (Heidelberg: ex officina Commeliniana, 1603).

64.French royal magistrates in the late 15th century typically owned around 60 books; Geneviève Hasenohr, in Histoire des Bibliotheques Françaises, I: Les bibliothèques médiévales, du VIe siècle à 1530, ed. André Vernet (Paris: Promodis, 1988), 239. In the 16th century French magistrates ordinarily owned 500-1000 books and up to 3000 books in exceptional cases. See Annie Charon-Parent, "Les grandes collections du XVIe siècle," Histoire des bibliothèques françaises, II: Les bibliothèques sous l'ancien régime 1530-1789, ed. Claude Jolly (Paris: Promodis, Editions du Cercle de la Librairie, 1988), pp. 85-90.

65.Albert Derolez, Les catalogues de bibliothèques, Typologie des sources du moyen âge occidental, fasc. 31 (Turnhout: Brepols, 1979).

66.See Graham Pollard and Albert Ehrman, The distribution of books by catalogue from the invention of printing to A.D. 1800 (Cambridge: for the Roxburghe Club, 1965) and Les ventes de livres et leurs catalogues XVIIe-XXe siècles, ed. Annie Charon and Elisabeth Parinet (Paris: Ecole des Chartes, 2000). For an example see The auction catalogue of the library of J. J. Scaliger, ed. H. J. de Jonge (Utrecht: HES publishers, 1977).

67.For an example of elaborate cataloging at the cathedral library of Zurich, see Martin Germann, Die reformierte Stiftsbibliothek am Grossmünster Zürich im 16. Jahrhundert (Wiesbaden: Harrassowitz, 1994); on late 16th and 17th-century librarians and a number of their classifications, see Maurice Caillet, "Les bibliothécaires," in Histoire des bibliothèques françaises. Les bibliothèques sous l'ancien régime 1530-1789, ed. Claude Jolly (Paris: Promodis, 1988), pp. 373-89.

68.See Sears Jayne, Library catalogues of the English Renaissance (Berkeley: University of California Press, 1956). For examples of catalogs formed by annotating a printed catalog or from alphabetized manuscript slips glued onto sheets, see the late 17th century catalogs of the Bibliothèque Mazarine, Paris, MS 4138 and 4134 respectively. Concerning the first library catalog on cards, see Markus Krajewski, Die Geburt der Kartei aus dem Geist der Bibliothek (Berlin:

Kulturverlag Kadmos, 2002), pp. 35ff. On the use of slips more generally see Ann Blair, forthcoming Yale University Press.

69.Medieval bibliographies were few in number and generally focused on a geographical area or a religious order; see Mary Rouse and Richard Rouse, "Bibliography before print: the medieval de viris illustribus," in The role of the book in medieval culture, Proceedings of the Oxford International Symposium, 26 Sept- 1 Oct 1982, ed. Peter Ganz (Turnhout: Brepols, 1986), I, pp. 133-53.

70.On Gesner see Helmut Zedelmaier, Bibliotheca universalis und bibliotheca selecta: das Problem der Ordnung des gelehrten Wissens in der frühen Neuzeit (Cologne: Böhlau, 1992); and (among other articles) Jan-Dirk Mueller, "Universal Bibliothek und Gedächtnis. Aporien frühneuzeitlicher Wissenskodifikation bei Conrad Gesner (Mit einem Ausblick auf Antonio Possevino, Theodor Zwinger und Johann Fischart)," in Erkennen und Erinnern in Kunst und Literatur, Kolloquium Reisensburg, 4-7 Januar 1996 (Tübingen: Max Niemeyer, 1998), pp. 285-310.

71.François Grudé, Sieur de La Croix du Maine, Premier volume de la Bibliothèque (Paris: L'Angellier, 1584), sig. aiijr.

72.See Charles B. Schmitt, Aristotle and the Renaissance (Cambridge, Mass: Harvard University Press, 1983); Laurence Brockliss, "Classification des sciences dans le monde universitaire et les facultés de médecine (1540-1640)," Nouvelle revue du seizième siècle 20 (2002), pp. 31-46.